

Supplemental Student Workbook and Reader

California Education and the Environment Initiative

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Science Standard
6.6.a.



Energy: It's Not All the Same to You!

California Education and the Environment Initiative

The Education and the Environment Initiative Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency
California Natural Resources Agency
California Department of Education
Department of Resources Recycling and Recovery (CalRecycle)

Key Partners:

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Office of Education and the Environment

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Where Oil Comes From and How It Is Used



Microscopic plants and animals have lived in Earth's oceans for many millions of years.

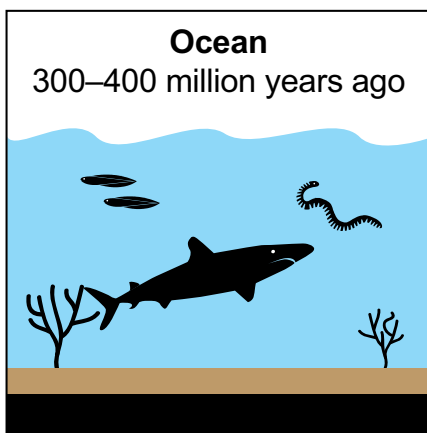
They float in the water or sink to the bottom when they die. There they decay and are covered by sand and silt. As the decaying material is buried on the ocean floor, it is crushed and heated by the pressure of the water and material above it. Over millions of years,

these conditions change the decaying organisms into other materials, such as crude oil. This material is also called petroleum. Crude oil is a nonrenewable resource that, like coal and natural gas, is called a "fossil fuel." Because it takes so long to form, like other

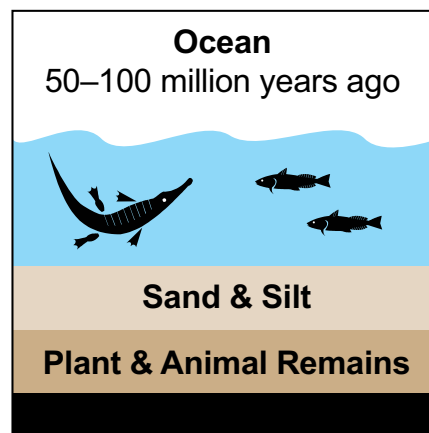
nonrenewable resources, Earth's supply of crude oil is limited.

Crude oil is slippery like the vegetable oil people use to cook. When it comes out of the ground, crude oil is thick like syrup. It is usually dark brown or black.

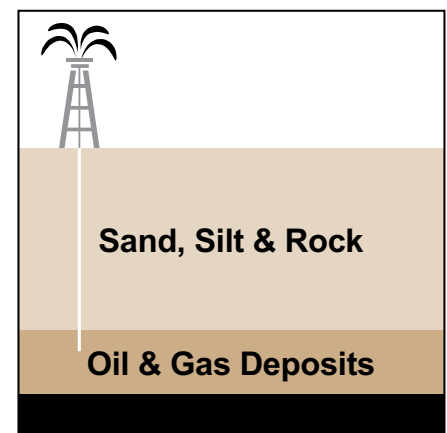
Petroleum and Natural Gas Formation



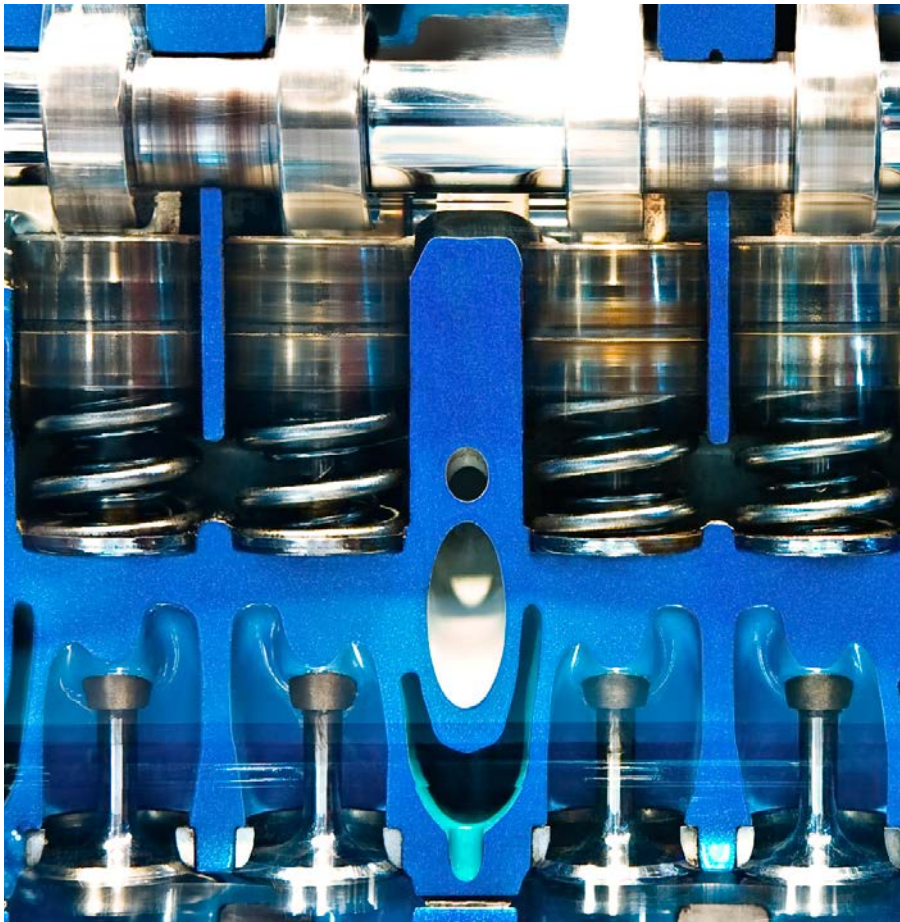
Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of silt and sand.



Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.



Today, we drill down through layers of sand, silt, and rock to reach the rock formations that contain oil and gas deposits.



Internal combustion engine

How we use energy from crude oil/petroleum

The energy in crude oil is converted into a useful form by burning it. Burning the oil converts the chemical energy into heat energy.

In the mid-1840s, Samuel Kier, a landowner in northwestern Pennsylvania, learned how to refine crude oil. A few years later, Kier

worked with a trained chemist to produce several different products that could be burned to release heat, converted into kerosene to produce light, or made into other materials.

In 1863, Jean Lenoir, a Belgian engineer, invented an internal combustion engine that could use petroleum as an energy

source. His invention was the first step in the process that led to today's use of petroleum that fuels most transportation.

Small explosions inside internal combustion engines burn gasoline and diesel fuel. Burning these fuels releases the energy that powers cars, trucks, and buses. Many airplanes, trains, and ships also use petroleum products to move them.

In California, transportation consumes over 40% of all the energy used. Petroleum products provide about 99% of this energy. Of the energy used for transportation in the United States, cars and small trucks consume about 60% of the energy, with medium and heavy duty trucks using more than 20%.

People also use petroleum products to warm their homes, stores, and factories. Many industries heat their furnaces with petroleum products that they use to smelt ores and melt metal for manufacturing.

Where we get oil

The crude oil that was formed long ago is deep underground or beneath the oceans. Some of it flows to the surface but most has to be found by drilling deep wells.

Once discovered, oil is moved by trucks, trains, barges, ships, and pipelines to refineries around the world. Most petroleum products California uses are refined in the United States.

Refineries produce about 45 gallons of petroleum products from each barrel of crude oil. Refineries make many different products from crude oil. Approximately 19 gallons of gasoline and 11 gallons of diesel fuel come from each barrel. The other 15 gallons become jet fuel, liquefied petroleum gases, and other products.

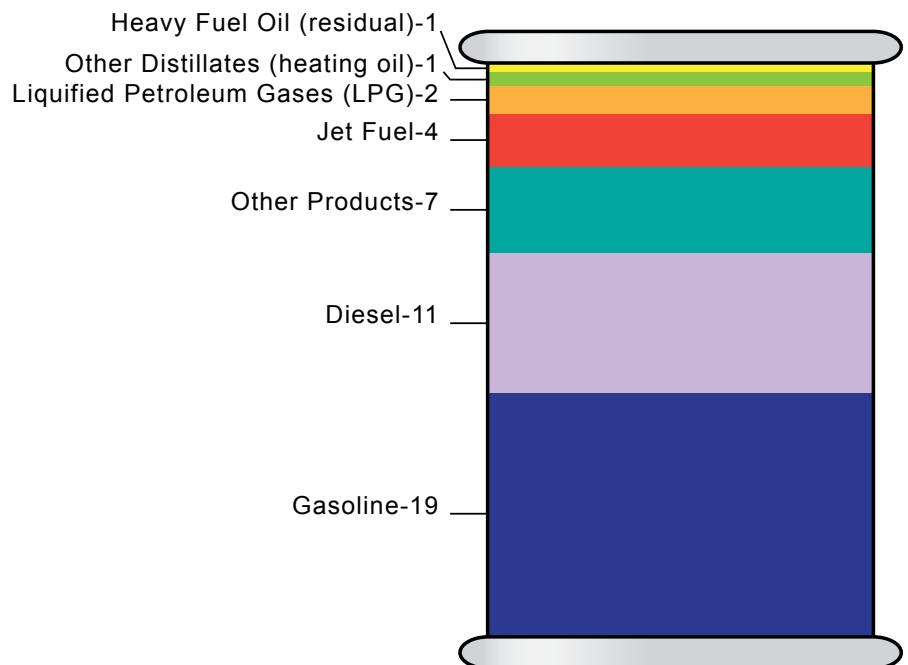
Petroleum products are moved from the refineries in different ways. Pipes take most of the products from the refineries to large terminals. They are then moved to distributors and service stations by pipelines, trucks, trains, and ships.

Byproducts and effects of using oil

Burning gasoline and diesel fuel in internal combustion engines releases gases. The primary emissions from internal combustion engines in passenger cars are hydrocarbons, carbon dioxide, carbon monoxide, nitrogen oxides, and water vapor. Burning these fuels can also emit tiny particles that cause health problems and have other effects.

Converting gasoline, diesel fuel, jet fuel, heating oil, and other petroleum products into other forms of energy also releases carbon dioxide, methane, and other byproducts into the atmosphere. The cars, trucks, buses, trains, ships, and airplanes that carry people and move things produce 27% of all carbon dioxide emissions in the United States.

Products Made from a Barrel of Crude Oil (Gallons) (2011)





Oil pipeline entering refinery

Releasing a large amount of carbon dioxide into the atmosphere can be a problem because carbon dioxide, like methane, is a “greenhouse gas.” Once in the atmosphere, large amounts of greenhouse gases act like a blanket, holding heat around the planet. This process, called the “greenhouse effect,” traps some of the Sun’s energy before it bounces out into space. When this happens, the temperature of Earth’s surface and oceans can

increase, causing changes to air and land temperatures over large areas. A change like this is called “global climate change.”

How using oil changes natural systems

Oil exploration, drilling, production, and transport can result in harmful effects on the environment, including land and water. Exploration and drilling can change the land. Oil and other chemicals

spilled during extracting, transporting, or refining crude oil can pollute the soil and water. The refineries that distill crude oil into gasoline, diesel fuel, kerosene, and other petroleum products, release methane gas and other byproducts into the atmosphere and water. Most refineries burn off the methane as it is released during the refining process. Burning off methane releases carbon dioxide into the atmosphere.



Oil spill entering wetland

There can also be other environmental effects from collecting, transporting, and refining crude oil including explosions, fires, noise, and odors. Government regulations are in place to prevent these problems, but accidents can happen.

The 2010 explosion of the Deepwater Horizon drilling platform in the Gulf of Mexico is one example of a major oil disaster. Very large amounts of crude oil were released into the gulf's waters. This killed millions of

fish, birds, and other ocean animals. The crude oil also affected the plants and

animals in wetlands along the coasts of Louisiana, Mississippi, Alabama, and Florida. Workers were killed by the explosion and many lost their jobs.

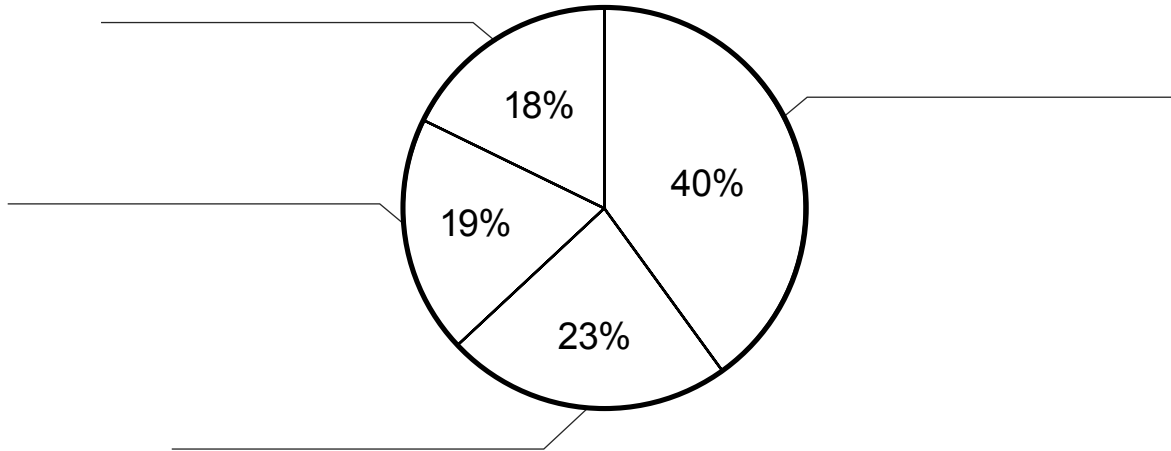
In 2012, an explosion at a refinery in Richmond, California, caused large amounts of smoke and pollutants to be released into the air, forcing nearby residents to stay indoors because of health concerns.



Oil refinery explosion

Name: _____

1. Record the names of the four energy end-use categories on the appropriate parts of the circle graph. (2 points each)



2. Which energy end-use category consumes the greatest percentage of California's energy? (2 points)

3. What is petroleum and how is it formed? (5 points)

4. Describe an example of how petroleum products are converted for use in transportation? (5 points)

Name: _____

5. Where do we get crude oil and petroleum products? (5 points)

6. What are the byproducts of refining crude oil and using it in internal combustion engines? (5 points)

7. How do exploring, drilling, producing, transporting, and using petroleum products influence natural systems? (5 points)

8. Identify three of the factors considered during “life-cycle assessment” that should be discussed when choosing an energy source for powering cars, trucks, and other modes of transportation?” (5 points each)



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